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JAPAN · ECONOMIC · INSTITUTE

JEI

REPORT

NO. 36A September 21, 1984

U.S.-JAPAN COMPETITION IN MACHINE TOOLS: AN UPDATE

Summary

The boom-and-bust U.S. machine tool industry is struggling to pull out of its deepest slump ever. The recession that started to engulf the domestic economy in 1980 brought an abrupt end to an incredible surge. It also eroded the complacency that had developed during the boom years since the slump exposed the fact that foreign competitors, particularly Japanese builders, were entrenched in the American marketplace. Thrown into upheaval by the recession and increased imports, the industry is undergoing a shakeout that should produce a group of strong survivors able to compete successfully with Japanese machine tool makers.

An Exhilarating Ride Up

The U.S. machine tool industry has been on a roller coaster ride over the past ten years like no other in the history of this boom-and-bust business. Orders for metal-cutting and metal-forming machine tools collapsed during the 1974-75 recession, tumbling to under $1.2 billion from a 1973 peak of $2.6 billion. But this slump quickly became a distant memory, blotted out by an unprecedented volume of orders from capital goods manufacturers. Bookings bounced back 88 percent in 1976 and another 34 percent the next year to $3 billion. This new record was broken almost as soon as it was set, though, as orders shot up to $4.3 billion in 1978 and then to an almost unbelievable $5.6 billion in 1979.

Detroit's multibillion-dollar program to retool production lines for the manufacture of downsized vehicles ignited this order boom, but U.S. car and truck makers, while the best customers, were not alone in booking big orders for machine tools in the late 1970s. Orders poured in from commercial aircraft manufacturers for equipment that would help them turn out a new generation of fuel-efficient jet transports. The oilfield machinery industry also became a major market for American machine tool producers with the worldwide increase in oil and gas drilling activity. Other large orderers included construction and farm machinery manufacturers. They, like a long list of American equipment makers fighting to maintain international competitiveness, needed new tooling to increase productivity, control production costs and implement design changes. Coming full circle, machine tool builders numbered among their own best customers since the flood of orders from other capital goods suppliers triggered stepped-up investments in plant expansion and modernization.

While U.S. machine tool builders were profiting from the retooling of the American production base, the recession that was crippling one industry after another began to show up on the order books. Bookings dropped 15 percent in 1980, but since they still added up to an extraordinarily robust $4.8 billion, industry executives and analysts saw little reason to change their bullish projections for the machine tool business in the early 1980s. Discounting developments that had signaled the onset of a slump in the past -- high and rising interest rates, falling capacity utilization, weak corporate profits and pared-back capital spending plans, most industry participants predicted that any order softening would be slight and temporary. Even if these forecasts proved wrong, it was reasoned, the industry was in a good position to ride out a dry spell because of its huge backlog of unfilled orders.

The flood of orders from automotive makers and other key U.S. capital goods industries had left American machine tool builders on the losing end of a battle against mounting backlogs and stretched-out delivery times since around the middle of 1976. From $1.1 billion at that point, the backlog of unfilled orders ballooned to $2.2 billion in December 1977, $3.5 billion in December 1978 and then to $5.4 billion in December 1979 before topping out at $5.6 billion in May 1980. At the end of 1980, the industry was still sitting on a $5.5 billion backlog. Unfilled orders for transfer lines -- machinery designed for long production runs of a single part or family of parts -- made up a fourth of this total. Long lead times are normal for special-purpose machines that must be custom engineered and built, so the big backlog for transfer lines was not without precedent. What was surprising was that unfilled orders for machining centers, numerically controlled (NC) lathes and manually operated lathes -- all standard machines -- also represented a quarter of the aggregate backlog.

Just as industry executives and analysts had predicted, the huge backlog of unfilled orders insulated U.S. machine tool production at the start of the 1980s from the worst effects of the rapidly spreading recession. Shipments, which had shot up from $2.5 billion in 1977 to $4.1 billion in 1979, hit $4.8 billion in 1980. And the boom had still not spent itself; in 1981, machine tool builders turned out an awesome $5.1 billion worth of equipment.

The JEI REPORT (ISSN 0744-6489) is published weekly for $40 per year by the Japan Economic Institute of America, 1000 Connecticut Avenue, N.W., Washington, D.C. 20036. Second class postage paid at Washington, D.C. POSTMASTERS: Send address changes to JEI, 1000 Connecticut Avenue, N.W., Washington, D.C. 20036.

Production of transfer machines fueled this explosive growth, multiplying 2.8 times over the five-year period to $896 million, but machining centers nearly matched this feverish pace, with shipments climbing 175.7 percent to $483 million. Not far behind were NC lathes, up 126 percent to $441 million. Other machine tools in rapidly increasing demand by U.S. industry during the 1977-81 timespan included grinding machines, particularly cylindrical grinders, and milling machines, notably profilers.

A Bust Like No Other

The enormous order backlog postponed the U.S. machine tool industry's day of reckoning with the most devastating economic slump since the 1930s; it did not provide a permanent shield. From 1980's strong booking rate of $4.8 billion, orders sank below $3 billion the next year and then slowed to a $1.5 billion trickle in 1982. U.S. automotive makers, caught in a sales tailspin, sliced their orders in 1981 and again the following year. With domestic and foreign airlines putting purchases of new planes on hold, tooling demand from the aerospace industry also dried up during this period. So did bookings from manufacturers of construction and farm machinery as the bottom fell out of their markets at home and abroad. Any remaining hope that the machine tool industry could avoid a total bust evaporated in 1982 when one of the few remaining pillars of strength -- orders from the energy sector -- crumbled and an anticipated surge in defense-related spending failed to materialize.

Orders did perk up a little in 1983 with the first glimmerings of a turnaround in investment spending by American capital goods manufacturers, rising to $1.7 billion, but the upturn came too late and was too anemic to prevent the near collapse of U.S. machine tool production. Shipments, which had already tumbled to less than $3.8 billion from 1981's all-time high of $5.1 billion, sagged over the space of just twelve months to a scant $2.1 billion. Even this meager amount of business required the virtual depletion of the industry's backlog. The huge cushion that $5.6 billion worth of unfilled orders had provided machine tool manufacturers at the end of 1980 had shrunk by December 1983 to an uncomfortable $1 billion-plus.

In a double blow to hard-pressed American producers, arrivals of foreign-made machine tools did not drop off sharply as the order backlog was whittled down and lead times were reduced to acceptable levels. On the contrary, foreign builders continued to gain market share. At the start of the boom in 1976, imports accounted for a relatively modest 15.9 percent of the U.S. machine tool business, with sales concentrated in low-technology manually controlled machines like engine lathes. Over the next two years, though, purchases from abroad more than doubled to $705 million as foreign builders parlayed their shorter delivery times into a 22.1 percent share of the American market. Equally ominous, overseas suppliers began to make inroads into what were bread-and-butter product lines for many domestic makers -- small and medium-sized numerically controlled lathes and machining centers.

With average lead times for American-made machine tools stretching out from 11 months at year-end 1978 to 13 months in December 1979 and then to a year and a half at the end of 1980, foreign manufacturers continued to expand their U.S. market presence. They were particularly successful in winning

contracts for standard NC machine tools from the thousands of job shops that act as parts subcontractors for automotive, aerospace and nonelectric machinery companies. Small buyers like these businesses tended to be slighted by domestic builders in favor of customers that ordered the big-ticket, sophisticated products in which American suppliers excel. But this neglect played right into the hands of the competition. Imports doubled betweeen 1978 and 1981 to $1.4 billion, landing foreign machine tools 25.6 percent of the overall market, including 42.2 percent of NC lathe sales and 31.3 percent of machining center shipments.

Job shops and other small users were not the only customers lost to the American machine tool industry, builders quickly discovered when they tried to drum up business in the recession's wake. Buyers representing a cross section of key capital goods manufacturers were also placing orders with foreign suppliers, sold by the combination of technological sophistication and competitive pricing they offered, not just on standard NC machine tools but also on products that were once the virtual domain of U.S. makers. Together, these customers helped to expand the market penetration of imports to 27.9 percent in 1982 and a deep 34 percent last year, when deliveries totaled $0.9 billion -- just 36.7 percent below peak shipments.

Entrenched Japanese Rivals

Far more than any other group of foreign machine tool producers, Japanese builders were in a position in the late 1970s to capitalize on the sales opportunities created by the U.S. industry's mounting backlog of unfilled orders. Machine tool manufacturers in Japan had earmarked significant portions of their research and development budgets in preceding years for work on compact, standardized numerically controlled machines tailored to the requirements of small and medium-sized customers. This emphasis was not accidental. Orders from Japanese parts subcontractors had kept many builders afloat during periods of weak demand from their primary customers -- Japan's big automotive and nonelectric machinery companies.

In another competitive plus for the Japanese machine tool industry, makers had invested relatively large amounts of money during the 1970s to automate their production processes. As a result, NC lathes and machining centers were being produced on assembly lines in Japan while U.S. builders were still turning out these tools one at a time. Moreover, Japanese firms manufactured standard NC machines for stock, which not only shortened delivery times but also maximized the cost advantages of assembly line production. Lower costs automatically gave Japanese vendors a pricing edge on their American counterparts, but this margin widened during the recession years of the mid-1970s as competition at home for sales of NC lathes and machining centers drove Japanese prices even lower.

With Japanese builders beating American producers of standard NC equipment on delivery time, design and price and at least matching them on after-sales service, machine tools made in Japan won quick acceptance in the U.S. marketplace, to put it mildly. Imports more than tripled between 1976 and 1978 to $213 million and then repeated this feat over the period through 1981, hitting $693 million. Numerically controlled lathes and machining centers made up nearly two-thirds of this sales tally, which netted Japanese suppliers a

12.3 percent stake in the U.S. machine tool business. Incredibly, producers in Japan shipped more NC lathes to American job shops and other domestic buyers in 1981 than U.S. companies did (3,209 versus 2,021) and almost tied them on shipments of machining centers (1,944 versus 2,081), even though American builders had their factories operating at capacity that year.

The days of easy U.S. sales for Japanese machine tool manufacturers were numbered, it turned out, but industry executives were slow to recognize this fact, proving no more adept than their American counterparts at anticipating how fast and hard the recession would hit business. Even as demand was taking a nosedive in the first part of 1982, deliveries from Japan continued to expand. Shipments slowed later in the year, but the cutback occurred too late to prevent an inventory buildup here of Japanese-made machine tools. How big these inventories were was the subject of much speculation in the U.S. industry, but even distributors of Japanese products acknowledged that they were sitting on costly excess stocks.

To move these inventories in the increasingly depressed U.S. market, Japanese machine tool makers offered potential customers attractive financing packages, including below-market interest rates and deferred payments, as well as liberal tryout terms. They also resorted to price discounting to win what little business there was. American builders initially resisted discounting, opting instead to attract buyers with other types of incentives while holding the line on price increases. As market conditions continued to deteriorate into 1983 and the pricing of Japanese-made machine tools became more aggressive, however, U.S. manufacturers joined the discounting fray. This proved to be a no-win situation, at least in the area of standard NC equipment, since their Japanese competitors had larger profit margins with which to work. Part of this pricing flexibility reflected the windfall obtained from the yen's depreciation in the 1982-83 period. More importantly, Japanese machine tool exporters had hiked list prices during the boom years to cash in on surging U.S. demand.

A Hard Landing for Builders

The recession and Japanese competition took a heavy toll last year on U.S. machine tool builders, both large and small. Just two years after it earned a record $96.9 million on all-time-high machine tool sales of $639.5 million, Cincinnati Milacron Inc., the industry's undisputed leader, lost $4.7 million in 1983 on sales of $283.8 million. Cross and Trecker Corp., the second or third largest producer in most years, fared no better, going from peak earnings of $72.1 million on company-wide revenues of $408.9 million in the year through September 1981 to a loss of $2.4 million on sales of $149.9 million in the October 1982-September 1983 period. The list of big American machine tool manufacturers awash in red ink goes on -- Allied Corp., Textron Inc., Ex-Cell-O Corp., White Consolidated Industries Inc., Acme-Cleveland Corp., Ingersoll Milling Machine Co. Few, if any, of the industry's largest members made money on machine tools in the 1983 accounting year.

A significant number of the small, privately owned companies that typify the U.S. machine tool industry closed their doors during the 1982-83 bust, unable to afford the luxury of riding out their losses. Others sold out to

larger competitors. Takeovers, both by domestic and foreign companies, thinned the ranks of independent second-tier manufacturers as well. At least one top player also decided to pull out of the business. In April of this year, Allied sold the machine tool and other automation group operations of its recently acquired Bendix Corp. unit to Cross and Trecker for the bargain price of $65 million plus stock warrants.

Hard-hit U.S. machine tool makers would have gladly traded places with their Japanese competitors, but Japanese builders were no more able to escape the effects of weak demand at home and abroad than American manufacturers. Orders from domestic customers fell in 1982 and then leveled off in reaction to back-to-back declines in bookings from the pivotal automotive and nonelectric machinery industries. With exports, which absorbed up to two-fifths or so of output during the boom, taking up virtually none of this order slack, Japanese machine tool production tumbled from its 1981 peak of Y1,057 billion ($4.8 billion), contracting by 10.5 percent in 1982 and by a slightly larger margin last year to Y842 billion ($3.5 billion).

Magnified by one of the price wars that periodically sweep the Japanese machine tool industry, this production slide was reflected in the reduced sales and slim profits or even losses reported in FY 1982 and FY 1983 by builders in Japan. Okuma Machinery Works, Ltd., for example, saw its machine tool revenues drop from a record Y52 billion ($229 million) in the April 1981-March 1982 period to about Y39 billion ($166 million) in the business year ending March 1984. Similarly, Toyoda Machine Works, Ltd., which vies with Okuma as Japan's biggest producer of metal-cutting machine tools, sold only about Y43 billion ($182 million) worth of equipment in FY 1983, off from its FY 1981 peak of Y49 billion ($213 million). Other top manufacturers -- including Toshiba Machine Co., Ltd., Mori Seiki Co., Ltd., Makino Milling Machine Co., Ltd., Hitachi Seiki Co., Ltd. and Osaka Kiko Co., Ltd. in the metal-cutting sector and Amada Co., Ltd., Aida Engineering, Ltd. and Komatsu, Ltd. among the makers of metal-forming machine tools -- had similar results.

The Japanese machine tool industry also had its share of dropouts, mergers and tie-ups. This past spring, Ikegai Corp., a medium-ranked maker that lost money in both FY 1982 and FY 1983, linked up with Tsugami Corp., another second-tier producer, to market and possibly manufacture products. About the same time, Okuma, Amada and struggling Wasino Machine Co., Ltd. announced that they were going to jointly develop, manufacture and market NC lathes and grinders. Moreover, on October 1, 1984, Toyama Machine Works, Ltd. will take over Nippei Industrial Co., Ltd., like it, a medium-sized builder.

A Fight for Survival

If there is a silver lining to the upheaval in the U.S. machine tool industry, it is that stiff Japanese competition on top of the recession has forced American companies that want to remain in the business to confront problems that they might have otherwise skirted. Consequently, builders like Cincinnati Milacron and Cross and Trecker are much stronger competitors today than they were at the height of the boom. Even in the face of an earnings slide, the leading vendors resisted making any deeper cuts in their capital spending and R&D budgets than were absolutely necessary. Over the 1981-83 period, for example, Cincinnati Milacron's machine tool group invested

$77 million in plant and equipment, while Cross and Trecker spent $46 million plus another $13 million on R&D.

A substantial portion of these monies was put into new product development, particularly in the area of flexible automation (loosely described as machine tools joined in cells or systems). Builders also introduced flexible automation and technically sophisticated stand-alone machine tools into their own operations to improve manufacturing efficiencies. Production capacity was expanded as well as modernized to minimize the impact of delivery times in a customer's buying decision.

While trying to maintain capital spending and R&D funding at pre-recession levels, U.S. machine tool builders were on a cost-cutting drive. The upgrading of the manufacturing base played a key role in this campaign; so did the consolidation of production in newer facilities. Labor costs were trimmed, in large part by reducing the work force, and marketing and distribution systems were revamped. Through steps such as these, bigger companies in particular were able to lower the volume of sales needed to make a profit. Cross and Trecker, for one, reduced its breakeven point to approximately $150 million from $200 million.

A number of large domestic manufacturers also decided to go head-to-head with their Japanese competitors in standardized numerically controlled equipment. Over the space of roughly twelve months in the early 1980s, Cincinnati Milacron, Kearney & Trecker (a Cross and Trecker subsidiary), the Pratt & Whitney Machine Tool division of Colt Industries Inc. and Bendix's Warner & Swasey Co. unit all introduced small NC lathes and/or machining centers featuring a limited number of options. These new models were built on assembly lines and priced comparably with Japanese products. The competitiveness of these machines never received a fair test, however, since they went into distribution just when the recession started to cut into orders.

Some leading U.S. producers took the opposite tack, conceding part or all of the market for commodity machine tools to foreign builders and concentrating their financial resources and manpower on the high technology product lines in which American producers have an edge. At the same time, though, most of these companies signed supply agreements with overseas makers so that they could maintain at least a minimal presence in standard equipment lines. Acme-Cleveland, for example, is sourcing a complete line of machining centers from Mitsubishi Heavy Industries, Ltd., while Bendix, before its sale to Cross and Trecker, was marketing Toyoda's full line of machining centers.

Even builders that introduced products designed to compete head on with Japanese suppliers are rounding out their lines with equipment imported from Japan. As one example, Colt Industries' Pratt & Whitney Machine Tool division is selling machining centers and NC lathes manufactured by Fanuc, Ltd. This fall, moreover, Kearney & Trecker will start distributing an Ikegai machining center as the low end of its line.

A few companies have taken the middle route, producing commodity NC lathes or machining centers under license from a Japanese manufacturer. Perhaps the best-publicized example of this type of arrangement is LeBlond Makino Machine Tool Co., which makes Makino-licensed machining centers in

addition to its traditional line of NC lathes. But there is a twist here: Makino has owned a 51 percent interest in the second-tier builder since 1981.

Investments in modernization and development of new product and process technologies, supplemented by supply or licensing agreements, are unquestionably the keys to a broadly competitive U.S. machine tool industry. The drawback to this prescription is that the small, privately owned companies that form the industry's backbone have neither the cash flow nor the access to outside sources of funds to underwrite these survival steps. Even big machine tool builders have been strapped for adequate plant and equipment and R&D resources. Being part of a conglomerate, as many large and medium-sized producers are, does not eliminate the funding problem if the parent views the machine tool unit as a drain on earnings rather than a long-run profit center.

Given the industry's financial problems and the perceived linkage between these troubles and increasing import competition, it is not surprising that machine tool builders have turned to Washington for help. What is significant is that these manufacturers have eschewed the traditional import-relief routes taken by other protection-minded U.S. industries. Instead, they have pursued novel or at least unusual approaches to stop imports in their tracks.

Houdaille Industries Inc., a medium-sized machine tool producer, fired the first shot in May 1982 when it asked President Reagan to deny investment tax credits to American companies that buy Japanese-made machining centers and NC punching machines. Houdaille's unique complaint was based on Section 103 of the 1971 Revenue Act, which empowers the president to disqualify foreign equipment from eligibility for investment tax credits if he finds that the equipment is the product of a government-backed cartel.

The charge that Japanese-made machine tools benefited from a government-supported cartel struck a responsive chord among those U.S. government and congressional representatives anxious to document how Japan's industrial policies hurt competitors in other countries. At the same time, though, many administration officials as well as industry executives questioned the accuracy of Houdaille's allegations, not to mention the present-day relevance of activities that purportedly occurred 20 years ago. There was also concern that a favorable ruling could open the flood gates to complaints from manufacturers in other industries threatened by foreign competition, plus invite retaliation from abroad. With his policy advisers split over the Houdaille petition, President Reagan finally had to step in and make the decision in April 1983 to take no action on this unique bid for protection.

The machine tool industry's current drive for import relief has also divided the Reagan administration. In March 1983, the National Machine Tool Builders' Association (NMTBA) appealed to the White House for across-the-board protection from foreign suppliers on national securities grounds. Tapping little-used Section 232 of the 1962 Trade Expansion Act, the trade association argued that the rising tide of imports threatens to cripple an industry critical to this country's "defense and deterrance posture." To maintain sufficient production capacity for national emergencies, the NMTBA asked the government to roll back aggregate machine tool imports to 17.5 percent of the

U.S. market for the next five years. It also requested that import penetration in any one of 18 product lines be capped at 20 percent of domestic sales.

This plea for a "breathing spell" has won the backing of Commerce Secretary Malcom Baldrige, but the Department of Defense is said to be cool to the idea, in part apparently because defense contractors have come out strongly against the proposal. The reaction of other department and agency heads involved in trade issues reportedly ranges from lukewarm support to outright opposition.

Opponents are understandably worried that curbs on machine tool imports for national security reasons could trigger foreign retaliation against U.S. exports, perhaps on similar grounds, as well as spur a spate of pleas from other industries seeking import protection on this basis. There is also recognition that stiff import restrictions are a short-sighted solution to the machine tool industry's problem, as even some builders concede. With President Reagan under no statutory deadlines to decide whether or not to give machine tool makers the sweeping protection they want, and other trade issues requiring resolution, divisions among policymakers could indefinitely delay a White House response.

Looking to the Future

While many other capital goods industries surge ahead in the currently booming U.S. economy, the machine tool business remains in the doldrums. The weak recovery in orders that began in 1983 has gathered some steam this year, but import penetration is up several more notches and pricing continues to be tight. Machine tool executives and analysts therefore doubt that the domestic industry will spring back to its 1979-81 peak levels during this economic cycle. Some even question whether American builders will ever top their earlier records.

U.S. manufacturers, however, are not ready to concede the American marketplace to their foreign rivals. The companies that survive the industry's current problems will be world-class competitors, it is argued. They will be particularly strong in the fast-emerging field of flexible automation. Here, builders like Cincinnati Milacron and Cross and Trecker say, American companies have a decided edge over Japanese suppliers since they have a track record of developing systems software for outside customers and providing them with applications engineering support. Japanese machine tool builders, despite their extensive in-house use of flexible automation, lack the critical experience of developing and installing systems for other manufacturers.

For further information, contact Susan MacKnight.

The views expressed in this report are those of the author and do not necessarily represent those of the Japan Economic Institute.

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Table 1: Estimated U.S. Machine Tool Orders, Shipments and Backlog, 1972-83

(in millions of dollars)

	Net New Orders	Shipments*	Year-End Backlog
1972	$1,412	$1,019	$ 963
1973	2,613	1,501	2,074
1974	2,502	2,031	2,546
1975	1,186	2,452	1,281
1976	2,230	2,060	1,452
1977	2,997	2,281	2,168
1978	4,344	3,013	3,498
1979	5,621	3,877	5,388
1980	4,754	4,692	5,451
1981	2,945	5,096	3,300
1982	1,498	3,604	1,194
1983	1,696	1,845	1,045

*These figures differ from the Department of Commerce shipment data cited below in part because they exclude machines valued under $2,500.

Source: National Machine Tool Builders' Association, Industry Estimate of Machine Tool New Orders, Cancellations, Shipments and Backlog.

Table 2: U.S. Apparent Consumption of Machine Tools, 1979-83

(in thousands of dollars)

	1979	1980	1981	1982	1983
Shipments	$4,064,045	$4,812,349	$5,111,253	$3,748,911	$2,114,078(p)
Exports	619,115	719,670	934,322	583,022	348,705
Imports	1,043,769	1,258,438	1,439,108	1,223,225	910,499
Trade Balance	-424,654	-538,768	-504,786	-640,203	-561,794
Apparent Consumption	4,488,699	5,351,117	5,616,039	4,389,114	2,675,872
Total Exports as Percent of Apparent Consumption	13.8%	13.4%	16.6%	13.3%	13.0%
Total Imports as Percent of Apparent Consumption	23.3%	23.5%	25.6%	27.9%	34.0%
Exports to Japan as Percent of Apparent Consumption	1.1%	1.0%	0.9%	1.1%	1.3%
Imports from Japan as Percent of Apparent Consumption	7.9%	9.2%	12.3%	12.1%	15.2%

Source: Derived from following tables.

Table 3: U.S. Shipments of Machine Tools, 1979-83

(in thousands of dollars)

	1979	1980	1981	1982	1983(p)
Metal-Cutting Machine Tools					
Lathes	$650,343	$826,960	$816,780	$525,662	$336,468
Numerically Controlled	347,717	481,162	441,371	333,379	224,554
Machining Centers	356,491	413,047	482,661	338,757	170,648
Grinding Machines	474,943	555,781	615,356	459,842	283,568
Numerically Controlled	28,646	32,907	46,710	42,404	42,716
Milling Machines	279,831	339,283	436,557	302,553	185,926
Numerically Controlled	93,828	162,685	190,620	205,766	108,914
Boring Machines	177,356	191,952	230,980	193,758	93,548
Numerically Controlled	69,634	92,455	120,208	110,717	37,100
Drilling Machines	150,470	166,857	139,971	102,703	53,009
Numerically Controlled	17,701	33,380	52,768	34,884	13,660*
Gear Cutting and Finishing Machines	607,550	813,565	896,141	674,804	235,002
Other Machines	229,070	278,636	295,362	237,635	174,078
Numerically Controlled	18,085	45,384	36,485	27,244	27,909
Total	3,037,205	3,716,370	4,046,940	2,922,245	1,568,014
Numerically Controlled	932,102	1,261,020	1,370,823	1,093,151	625,501
Metal-Forming Machine Tools					
Mechanical Presses	348,546	353,153	343,815	236,809	149,356
Hydraulic Presses	85,455	87,624	85,785	101,873	
Shearing and Punching Machines	181,212	204,185	206,108	137,916	116,098
Bending and Forming Machines	183,429	214,924	212,830	157,848	132,217
Forging Machines	84,722	73,818	79,003	78,844	46,156
Other Machines	143,476	162,275	136,772	113,376	102,237
Total	1,026,840	1,095,979	1,064,313	826,666	546,064
Total Machine Tool Shipments	4,064,045	4,812,349	5,111,253	3,748,911	2,114,078

*Three quarters only.

Source: U.S. Department of Commerce, Bureau of the Census, Current Industrial Reports: Metalworking Machinery (MQ-35W)

Table 4: Total U.S. Exports of Machine Tools, 1979-83

(in thousands of dollars, f.a.s. value)

	1979	1980	1981	1982	1983
Metal-Cutting Machine Tools					
Lathes	$53,007	$67,083	$90,044	$70,401	$34,939
Numerically Controlled	n.a.	22,985	24,125	33,535	14,988
Machining Centers	45,385	56,743	53,427	34,012	13,350
Grinding Machines	65,935	85,085	126,572	71,161	49,013
Numerically Controlled	n.a.	11,612	19,468	11,581	12,317
Milling Machines	23,489	19,178	37,800	41,350	13,895
Numerically Controlled	n.a.	3,900	22,540	30,722	5,036
Boring Machines	32,393	33,184	79,443	32,386	18,527
Numerically Controlled	n.a.	16,831	21,391	11,055	7,389
Drilling Machines	16,760	22,223	24,391	12,376	8,327
Numerically Controlled	n.a.	1,874	4,246	790	1,227
Gear Cutting and Finishing Machines	43,845	61,212	80,141	37,387	31,586
Station and Transfer Machines	43,274	51,686	97,248	36,389	21,128
Other Machines*	68,382	66,361	79,501	59,168	39,849
Numerically Controlled	n.a.	2,267	3,985	2,603	1,093
Total	392,470	462,755	668,567	394,630	230,614
Numerically Controlled	n.a.	116,212	149,182	124,298	55,400
Metal-Forming Machine Tools					
Mechanical Presses	19,191	27,691	22,925	23,917	10,357
Hydraulic Presses	32,624	42,002	56,451	29,924	19,610
Shearing and Punching Machines	22,342	44,794	44,945	32,929	18,061
Numerically Controlled	n.a.	13,187	13,758	8,302	2,616
Bending and Forming Machines	45,672	44,492	46,007	35,111	19,656
Numerically Controlled	n.a.	12,403	14,528	12,679	7,137
Forging Machines	20,240	16,434	21,326	15,299	7,932
Other Machines*	86,576	81,502	74,101	51,212	42,475
Total	226,645	256,915	265,755	188,392	118,091
Numerically Controlled	n.a.	25,590	28,286	20,981	9,753
Total Machine Tool Exports	619,115	719,670	934,322	583,022	348,705
Numerically Controlled	n.a.	141,802	177,468	145,279	65,153

*Includes machines valued under $2,500.

Source: U.S. Department of Commerce, Bureau of the Census, U.S. Exports (FT 410)

Table 5: U.S. Exports of Machine Tools to Japan, 1979-83

(in thousands of dollars, f.a.s. value)

	1979	1980	1981	1982	1983
Metal-Cutting Machine Tools					
Lathes	$1,222	$1,456	$1,914	$3,576	$1,416
Numerically Controlled	n.a.	419	727	2,379	1,340
Machining Centers	1,469	1,472	89	1,555	297
Grinding Machines	5,684	7,731	15,892	12,680	5,805
Numerically Controlled	n.a.	2,619	5,764	4,671	1,439
Milling Machines	3,689	2,512	1,019	66	0
Numerically Controlled	n.a.	1,799	0	66	0
Boring Machines	4,154	2,289	1,707	2,349	368
Numerically Controlled	n.a.	485	553	193	0
Drilling Machines	1,387	1,629	1,879	95	0
Numerically Controlled	n.a.	0	81	0	0
Gear Cutting and Finishing Machines	6,952	15,104	12,770	9,606	626
Station and Transfer Machines	4,596	3,218	1,046	1,258	19,210
Other Machines*	1,654	2,064	3,610	4,599	1,023
Numerically Controlled	n.a.	0	0	0	275
Total	30,807	37,475	39,926	35,784	28,745
Numerically Controlled	n.a.	6,794	7,214	8,864	3,351
Metal-Forming Machine Tools					
Mechanical Presses	1,037	3,163	1,446	2,659	1,350
Hydraulic Presses	1,005	2,557	1,027	1,084	263
Shearing and Punching Machines	1,560	1,756	2,058	1,092	281
Numerically Controlled	n.a.	124	1,227	149	124
Bending and Forming Machines	5,709	5,518	2,474	972	712
Numerically Controlled	n.a.	1,096	1,429	323	64
Forging Machines	4,706	655	2,156	5,829	743
Other Machines*	2,950	4,089	1,648	2,632	1,808
Total	16,967	17,738	10,809	14,268	5,157
Numerically Controlled	n.a.	1,220	2,656	472	188
Total Exports to Japan	47,774	55,213	50,735	50,052	33,902
Numerically Controlled	n.a.	8,014	9,870	9,336	3,539

*Includes machines valued under $2,500.

Source: U.S. Department of Commerce, Bureau of the Census, U.S. Exports (FT 410)

Table 6: Total U.S. Imports of Machine Tools, 1979-83*

(in thousands of dollars, Customs value)

	1979	1980	1981	1982	1983
Metal-Cutting Machine Tools					
Lathes	$353,557	$380,011	$479,787	$338,615	$165,697
Numerically Controlled	n.a.	185,845	304,363	218,973	113,484
Machining Centers	39,672	93,387	195,718	188,869	164,938
Grinding Machines	80,479	138,604	137,184	117,577	89,548
Numerically Controlled	n.a.	9,608	16,628	18,093	14,488
Milling Machines	82,881	138,147	124,742	87,695	52,482
Numerically Controlled	n.a.	23,398	27,408	15,541	13,562
Boring Machines	70,885	81,813	98,564	89,467	44,639
Numerically Controlled	n.a.	23,670	30,833	37,459	19,765
Drilling Machines	25,008	27,201	26,448	20,718	9,916
Numerically Controlled	n.a.	846	2,016	1,538	2,258
Gear Cutting and Finishing Machines	33,058	41,297	36,982	25,826	13,849
Station and Transfer Machines	n.a.	7,510	8,479	7,426	1,640
Other Machines**	147,536	126,587	149,486	160,102	154,194
Numerically Controlled	n.a.	15,151	7,555	14,270	5,271
Total	833,076	1,034,557	1,257,390	1,036,295	696,999
Numerically Controlled	n.a.	351,905	584,521	494,743	333,766
Metal-Forming Machine Tools					
Mechanical Presses	21,013	13,627	16,165	19,977	25,248
Hydraulic Presses	28,069	54,822	28,172	20,378	26,957
Shearing and Punching Machines	40,955	43,075	51,003	41,574	35,469
Numerically Controlled	n.a.	16,454	29,837	25,550	19,047
Bending and Forming Machines	30,294	33,591	30,091	31,750	34,887
Numerically Controlled	n.a.	3,648	2,649	3,493	7,432
Forging Machines	20,794	22,851	15,755	21,548	39,753
Other Machines**	69,568	55,915	40,532	51,703	51,186
Numerically Controlled	n.a.	3,057	1,930	13,228	920
Total	210,693	223,881	181,718	186,930	213,500
Numerically Controlled	n.a.	23,159	34,416	42,271	27,399
Total Machine Tool Imports	1,043,769	1,258,438	1,439,108	1,223,225	910,499
Numerically Controlled	n.a.	375,064	618,937	537,014	361,165

*Imports for consumption.
**Includes machines valued under $2,500.

Source: U.S. Department of Commerce, Bureau of the Census, U.S. Imports for Consumption and General Imports (FT 246)

Table 7: U.S. Imports of Machine Tools from Japan, 1979-83*

(in thousands of dollars, Customs value)

	1979	1980	1981	1982	1983
Metal-Cutting Machine Tools					
Lathes	$169,124	$205,422	$303,466	$203,088	$105,057
Numerically Controlled	n.a.	148,865	258,546	179,444	95,459
Machining Centers	33,929	85,172	183,854	168,137	151,378
Grinding Machines	17,433	32,249	31,051	27,804	12,877
Numerically Controlled	n.a.	4,186	6,648	6,426	3,466
Milling Machines	22,767	38,756	36,011	19,650	12,574
Numerically Controlled	n.a.	9,312	16,303	8,083	6,351
Boring Machines	26,307	24,422	35,440	21,305	13,743
Numerically Controlled	n.a.	10,406	17,197	12,645	6,803
Drilling Machines	8,001	9,661	8,544	3,952	2,816
Numerically Controlled	n.a.	0	494	118	1,558
Gear Cutting and Finishing Machines	5,882	3,674	1,561	1,418	464
Station and Transfer Machines	n.a.	3,785	185	0	0
Other Machines**	22,366	30,920	34,139	28,271	39,198
Numerically Controlled	n.a.	8,323	372	3,266	1,965
Total	305,809	434,061	634,251	473,625	338,107
Numerically Controlled	n.a.	266,264	483,414	378,119	266,980
Metal-Forming Machine Tools					
Mechanical Presses	4,875	3,635	9,772	15,174	20,032
Hydraulic Presses	2,704	17,096	10,810	7,625	9,658
Shearing and Punching Machines	18,769	20,468	23,351	21,608	19,148
Numerically Controlled	n.a.	10,615	16,305	14,883	12,615
Bending and Forming Machines	2,845	3,690	5,361	4,291	6,790
Numerically Controlled	n.a.	0	380	576	984
Forging Machines	5,267	5,337	4,423	3,446	7,573
Other Machines**	12,984	7,145	5,075	7,117	5,333
Numerically Controlled	n.a.	416	1,013	202	171
Total	47,444	57,371	58,792	59,261	68,534
Numerically Controlled	n.a.	11,031	17,698	15,661	13,770
Total Imports from Japan	353,253	491,432	693,043	532,886	406,641
Numerically Controlled	n.a.	277,295	501,112	393,780	280,750

*Imports for consumption.
**Includes machines valued under $2,500.

Source: U.S. Department of Commerce, Bureau of the Census, U.S. Imports for Consumption and General Imports (FT 246)

Table 8: Japan's Apparent Consumption of Machine Tools, 1979-83

(in thousands of dollars)

	1979	1980	1981	1982	1983
Production	$2,964,014	$3,826,068	$4,792,682	$3,797,968	$3,544,914
Exports	1,239,144	1,446,718	1,689,899	1,267,020	1,254,012
Imports	165,871	219,976	216,425	220,788	170,949
Trade Balance	1,073,273	1,226,742	1,473,474	1,046,232	1,083,063
Apparent Consumption	1,890,741	2,599,326	3,319,208	2,751,736	2,461,851
Total Exports as Percent of Apparent Consumption	65.5%	55.7%	50.9%	46.0%	50.9%
Total Imports as Percent of Apparent Consumption	8.8%	8.5%	6.5%	8.0%	6.9%
Exports to United States as Percent of Apparent Consumption	19.5%	19.9%	22.8%	18.9%	16.9%
Imports from United States as Percent of Apparent Consumption	2.5%	2.5%	1.5%	2.3%	2.0%

Source: Derived from following tables.

Table 9: Japan's Production of Machine Tools, 1979-83

(in thousands of dollars*)

	1979	1980	1981	1982	1983
Metal-Cutting Machine Tools					
Lathes	$713,753	$972,185	$1,040,446	$768,898	$668,108
Numerically Controlled	459,139	672,295	731,328	562,963	511,494
Machining Centers	284,463	491,383	749,787	649,853	701,368
Grinding Machines	235,776	331,705	439,666	357,081	293,634
Numerically Controlled	7,574	15,078	19,652	23,867	24,646
Milling Machines	233,170	260,485	338,542	302,530	274,819
Numerically Controlled	62,459	83,215	139,172	135,969	141,887
Boring Machines	120,566	135,607	159,023	123,574	108,429
Numerically Controlled	17,699	35,652	57,468	45,304	42,236
Drilling Machines	55,221	59,453	74,104	60,851	56,778
Numerically Controlled	6,197	8,710	9,722	7,380	17,817
Gear Cutting and Finishing Machines	49,398	67,290	89,449	48,472	40,392
Planing Machines	11,105	9,191	12,805	10,556	9,637
Electric Discharge Machines	143,299	195,929	228,770	234,102	281,618
Numerically Controlled	82,185	144,525	180,838	197,671	256,585
Special Purpose Machines	275,381	331,065	542,555	460,410	385,210
Numerically Controlled	18,549	28,370	53,147	39,795	62,799
Other Machines	138,690	153,874	184,978	126,722	136,755
Numerically Controlled	21,178	17,671	27,084	30,749	37,294
Total	2,260,820	3,008,168	3,860,125	3,143,048	2,956,749
Numerically Controlled	959,442	1,496,900	1,968,196	1,693,551	1,796,127
Metal-Forming Machine Tools					
Mechanical Presses	408,583	466,712	576,063	377,956	305,848
Hydraulic Presses	144,205	156,410	164,714	131,170	139,020
Shearing Machines	72,093	94,690	102,961	60,618	63,313
Bending Machines	17,012	24,953	24,327	29,697	24,310
Forging Machines	21,733	28,137	31,078	21,819	19,803
Wire Forming Machines	39,568	46,999	33,413	33,660	35,808
Total	703,194	817,901	932,556	654,921	588,165
Total Machine Tool Production	2,964,014	3,826,068	4,792,682	3,797,968	3,544,914

*The following average annual exchange rates were used to convert the yen production figures: 1979, Y214.14; 1980, Y226.75; 1981, Y220.54; 1982, Y249.05; and 1983, Y237.52.

Source: Japan, Ministry of International Trade and Industry, Yearbook of Machinery Statistics

Table 10: Japan's Total Exports of Machine Tools, 1979-83

(in thousands of dollars*, f.o.b. value)

	1979	1980	1981	1982	1983
Metal-Cutting Machine Tools					
Lathes	$379,752	$520,007	$577,432	$367,382	$301,477
Numerically Controlled	279,337	442,900	509,166	313,956	251,284
Machining Centers	139,255	269,913	432,530	294,331	331,093
Grinding Machines	131,140	115,568	112,208	99,546	82,713
Numerically Controlled	2,349	1,816	4,089	8,291	10,836
Milling Machines	62,909	74,764	77,382	61,111	61,922
Numerically Controlled	10,939	26,562	40,358	26,465	34,140
Boring Machines	80,103	53,975	59,547	42,325	41,064
Numerically Controlled	22,975	13,336	6,369	9,105	11,871
Drilling Machines	38,650	28,458	27,462	36,992	44,995
Numerically Controlled	3,078	4,274	3,257	5,453	15,195
Gear Cutting and Finishing Machines	24,434	13,886	10,979	7,751	9,976
Planing Machines	4,143	4,766	3,544	1,470	1,830
Electric Discharge Machines	28,824	46,616	41,380	34,813	61,236
Other Machines	61,006	56,118	70,737	51,243	63,376
Total	950,216	1,184,070	1,413,201	996,964	999,684
Numerically Controlled	457,933	758,800	995,770	657,602	654,420
Metal-Forming Machine Tools					
Mechanical Presses	96,438	67,990	58,490	80,030	45,261
Hydraulic Presses	34,232	30,222	26,868	35,072	43,680
Shearing and Punching Machines	47,331	55,826	75,926	50,413	51,280
Bending and Forming Machines	28,895	35,565	34,188	29,179	28,983
Forging Machines	26,345	20,759	23,826	13,496	24,888
Other Machines	55,687	52,286	57,399	61,866	60,236
Total	288,929	262,647	276,698	270,056	254,328
Total Machine Tool Exports	1,239,144	1,446,718	1,689,899	1,267,020	1,254,012

*The following average annual exchange rates, calculated by the Ministry of Finance, were used to convert the yen export figures: 1979, Y217.47; 1980, Y227.67; 1981, Y219.90; 1982, Y248.33; and 1983, Y237.52.

Source: Japan, Ministry of Finance, Japan Exports and Imports: Commodity by Country

Table 11: Japan's Exports of Machine Tools to the United States, 1979-83

(in thousands of dollars*, f.o.b. value)

	1979	1980	1981	1982	1983
Metal-Cutting Machine Tools					
Lathes	$183,232	$231,171	$338,118	$196,718	$120,169
Numerically Controlled	158,906	207,942	315,673	178,490	114,919
Machining Centers	60,649	119,386	222,164	165,897	170,581
Grinding Machines	17,036	28,901	27,942	25,293	13,691
Numerically Controlled	684	597	1,729	4,345	3,725
Milling Machines	11,822	26,322	38,362	16,448	10,172
Numerically Controlled	2,623	13,648	26,907	10,751	8,178
Boring Machines	17,867	21,958	20,585	15,889	4,557
Numerically Controlled	3,539	5,510	3,438	5,737	2,319
Drilling Machines	6,173	8,947	7,853	3,848	5,979
Numerically Controlled	28	137	1,255	411	4,864
Gear Cutting and Finishing Machines	7,265	2,672	1,466	1,680	507
Planing Machines	0	0	325	2	0
Electric Discharge Machines	9,330	20,929	14,002	10,536	23,644
Other Machines	10,567	8,941	22,262	11,202	15,218
Total	323,940	469,225	693,079	447,513	364,518
Numerically Controlled	226,429	347,220	571,185	365,630	304,586
Metal-Forming Machine Tools					
Mechanical Presses	12,626	10,051	11,803	31,705	11,597
Hydraulic Presses	6,573	2,350	7,115	3,389	4,911
Shearing and Punching Machines	13,102	23,629	34,230	21,275	21,006
Bending and Forming Machines	2,013	1,627	1,313	1,130	1,497
Forging Machines	6,174	6,661	4,401	3,024	4,043
Other Machines	5,006	2,770	5,018	10,809	8,252
Total	45,494	47,087	63,880	71,332	51,306
Total Exports to United States	369,434	516,313	756,959	518,845	415,824

*The folllowing average annual exchange rates, calculated by the Ministry of Finance, were used to convert the yen export figures: 1979, Y217.47; 1980, Y227.67; 1981, Y219,90; 1982, Y248.33; and 1983, Y237.52.

Source: Japan, Ministry of Finance, Japan Exports and Imports: Commodity by Country

Table 12: Japan's Total Imports of Machine Tools, 1979-83

(in thousands of dollars*, c.i.f. value)

	1979	1980	1981	1982	1983
Metal-Cutting Machine Tools					
Lathes	$17,102	$22,315	$27,353	$25,270	$14,188
Numerically Controlled	8,415	1,656	1,892	5,529	3,072
Machining Centers	0	0	0	0	0
Grinding Machines	35,133	55,731	67,524	67,729	43,631
Numerically Controlled	2,223	3,827	8,189	13,042	7,034
Milling Machines	18,128	23,111	15,341	14,145	9,633
Numerically Controlled	1,187	7,502	4,024	5,571	452
Boring Machines	8,659	5,828	7,771	5,990	2,969
Numerically Controlled	1,512	1,470	1,396	1,818	1,400
Drilling Machines	6,575	5,066	3,899	5,688	11,369
Numerically Controlled	217	2	0	1,490	1,903
Gear Cutting and Finishing Machines	17,272	32,321	29,892	32,951	11,121
Numerically Controlled	0	1,342	0	0	770
Planing Machines	134	83	- 0	258	286
Electric Discharge Machines	6,155	7,326	7,173	5,225	7,887
Numerically Controlled	1,549	2,924	4,184	3,481	5,597
Other Machines	11,389	15,965	16,656	18,277	35,776
Numerically Controlled	2,458	1,038	51	3,254	4,517
Total	120,548	167,747	175,609	175,533	136,861
Numerically Controlled	12,561	19,761	19,735	34,185	24,744
Metal-Forming Machine Tools					
Mechanical Presses	7,747	7,078	4,308	6,357	6,895
Numerically Controlled	0	0	0	0	352
Hydraulic Presses	3,958	5,091	1,766	5,416	4,069
Shearing and Punching Machines	2,996	5,376	4,401	3,442	4,647
Numerically Controlled	1,160	2,393	2,341	1,400	3,783
Bending and Forming Machines	9,591	10,932	6,466	3,490	3,648
Numerically Controlled	1,501	4,314	967	619	194
Forging Machines	8,171	8,062	11,157	15,858	3,648
Numerically Controlled	0	0	0	6	0
Other Machines	12,860	15,691	12,718	10,692	11,180
Numerically Controlled	376	418	1,237	1,267	1,560
Total	45,328	52,229	40,816	45,255	34,088
Numerically Controlled	3,036	7,124	4,545	3,293	5,890
Total Machine Tool Imports	165,871	219,976	216,425	220,788	170,949
Numerically Controlled	15,597	26,886	24,280	37,478	30,634

*The following average annual exchange rates, calculated by the Ministry of Finance, were used to convert the yen import figures: 1979, Y217.46; 1980, Y227.85; 1981, Y219.94; 1982, Y248.30; and 1983, Y237.59.

Source: Japan, Ministry of Finance, Japan Exports and Imports: Commodity by Country

Table 13: Japan's Imports of Machine Tools from the United States, 1979-83

(in thousands of dollars*, c.i.f. value)

	1979	1980	1981	1982	1983
Metal-Cutting Machine Tools					
Lathes	$1,814	$926	$3,076	$3,926	$341
Numerically Controlled	52	468	1,846	2,801	311
Machining Centers	0	0	0	0	0
Grinding Machines	6,516	12,044	16,941	17,544	8,802
Numerically Controlled	1,325	2,575	5,569	4,997	1,866
Milling Machines	4,829	7,660	1,497	884	1,488
Numerically Controlled	742	4,988	157	824	269
Boring Machines	1,937	765	728	1,556	585
Numerically Controlled	1,512	657	454	907	464
Drilling Machines	309	983	304	3,183	175
Numerically Controlled	210	2	0	1,426	4
Gear Cutting and Finishing Machines	8,447	14,310	10,180	12,610	1,687
Numerically Controlled	0	784	0	0	0
Planing Machines	0	0	0	0	0
Electric Discharge Machines	512	2,222	387	40	331
Numerically Controlled	0	556	0	0	254
Other Machines	2,575	3,310	2,639	4,907	24,852
Numerically Controlled	656	1	0	170	62
Total	26,938	42,219	35,752	44,650	38,262
Numerically Controlled	4,497	10,031	8,026	11,125	3,231
Metal-Forming Machine Tools					
Mechanical Presses	3,946	4,669	1,623	1,966	1,402
Numerically Controlled	0	0	0	0	0
Hydraulic Presses	1,554	1,618	228	407	264
Shearing and Punching Machines	264	2,571	2,432	1,602	2,249
Numerically Controlled	32	1,479	1,888	1,123	2,031
Bending and Forming Machines	5,153	6,670	2,295	1,197	966
Numerically Controlled	1,501	3,455	704	524	192
Forging Machines	4,818	492	2,098	7,555	1,477
Numerically Controlled	0	0	0	6	0
Other Machines	5,068	7,478	6,410	4,892	4,056
Numerically Controlled	0	418	1,237	323	732
Total	20,803	23,497	15,087	17,619	10,414
Numerically Controlled	1,533	5,352	3,828	1,976	2,955
Total Imports from United States	47,742	65,715	50,839	62,269	48,676
Numerically Controlled	6,030	15,383	11,854	13,102	6,186

*The following average annual exchange rates, calculated by the Ministry of Finance, were used to convert the yen import figures: 1979, Y217.46; 1980, Y227.85; 1981, Y219.94; 1982, Y248.30; and 1983, Y237.59.

Source: Japan, Ministry of Finance, Japan Exports and Imports: Commodity by Country